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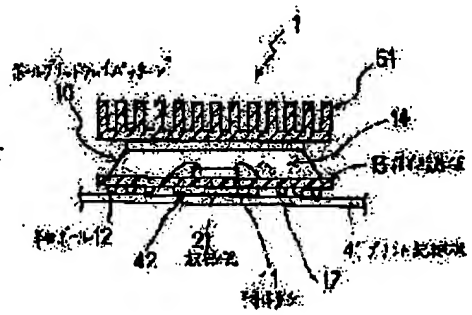
(71)Applicant : **SUMITOMO KINZOKU ELECTRO DEVICE:KK**
(72)Inventor : **FUKUNAGA NORIKAZU**

(54) BALL GRID ARRAY PACKAGE AND PRINTED BOARD

(57)Abstract:
PROBLEM TO BE SOLVED: To improve the heat radiating property, by a method wherein a heat radiating board in excellent thermal conductivity is junctioned with the bottom face side of the semiconductor element mounting part of a resin substrate having the semiconductor element mounting part on the top face side, with the junctioning pad of a solder ball on the bottom face side.
SOLUTION: A ball grid array package 10 is provided with a resin substrate 13 having the mounting part of a semiconductor element 11 on the top face side thereof while having a solder ball junctioning pad on the bottom face side thereof. On the other hand, a heat radiating board 21 in excellent thermal conductivity is junctioned with the bottom face side of the semiconductor element mounting part of the resin substrate 13. Resultantly, the heat dissipated from the bottom face of the semiconductor element 1 is radiated to a printed substrate 41 in almost the shortest distant path. Besides, the heat radiating board 21 formed of a material in excellent thermal conductivity such as copper, etc., also takes a planar shape at the lower thermal resistance, thereby enabling the semiconductor element 11 to efficiently radiate the heat to the printed wiring board 41.



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MEANS

[Means for Solving the Problem] Invention of the claim 1 of this application is a ball grid array package carried in a printed wired board through a solder ball, it had the loading section of a semiconductor device, equips the upper surface side with the resin substrate which has a pad for junction of the above-mentioned solder ball in an inferior-surface-of-tongue side, and is in the ball grid array package characterized by joining the good heat sink of heat conduction to the inferior-surface-of-tongue side of the semiconductor device loading section of the above-mentioned resin substrate.
[0006] What should be observed especially in this invention is having joined the good heat sink of heat conduction to the inferior-surface-of-tongue side of the semiconductor device loading section of a resin substrate. By preparing such a heat sink, thermolysis of generation of heat emitted from the inferior surface of tongue of a semiconductor device is attained in the path of the simultaneously curtate distance which passes along the board thickness of a resin substrate, and the board thickness of the above-mentioned heat sink. And heat can be emitted good to the exterior (when carried in the atmosphere or a printed wired board, it is the same a printed wired board and the following) by minding the heat sink which heat conduction is formed with a good material, and has a board configuration with little [geometrically] thermal resistance. Moreover, the structure which joins a heat sink to a resin substrate is very simple, manufacture is easy, and elevation of cost has the advantage of being few.
[0007] As the quality of the material of the above-mentioned heat sink, there are metals, such as aluminum, copper, a copper tungsten, and covar. In addition, it is still more desirable to prepare the thermal beer according to claim 7 for promoting heat conduction between the semiconductor device loading section of a resin substrate and a heat sink like. It is because the thermal resistance between the inferior surface of tongue of a semiconductor device and a heat sink can be sharply decreased with thermal beer.
[0008] Next, invention of the claim 2 of this application is a ball grid array package carried in a printed wired board through a solder ball, opening of the resin substrate which has a pad for the above-mentioned solder ball junction in an inferior-surface-of-tongue side while preparing opening in the helicopter loading site of a semiconductor device, and the above-mentioned resin substrate is equipped with it, carries the above-mentioned semiconductor device in the upper surface, and is in the ball grid array package characterized by to have the metal block which comes to open an inferior-surface-of-tongue side wide in the open air.
[0009] As for what should be observed especially in this invention, the semiconductor device is carried in the metal block instead of a resin substrate, and a metal block is having opened the undersurface wide in the direct open air. Therefore, opening which arranges a metal block is prepared in the helicopter loading site of the semiconductor device of a resin substrate. By carrying a semiconductor device in a metal block as mentioned above, it is connected by the metal block with small thermal resistance between the undersurface of a semiconductor device, and the open air (when carried in a printed wired board, it is the same a printed wired board and the following), and it becomes very good [heat dissipation].
[0010] As the quality of the material of the above-mentioned metal block, there are metals, such as aluminum, copper, a copper tungsten, and covar. And there is a plate according to claim 11 joined to the undersurface of a resin substrate in the configuration of the above-mentioned metal block like (refer to drawing 2). Such a configuration is very simple, manufacture is easy, and the rise of cost has the advantage of being few.
[0011] Moreover, there are some which are constituted by the expressional section according to claim 12 with which the undersurface of a resin substrate was equipped like, and the element loading section which protrudes on the upper part from this expressional section, and inserts in the aforementioned opening as other configurations of the above-mentioned metal block, and structure (refer to drawing 3). With this structure, since the level difference of the upper surface of a resin substrate and the upper surface of a semiconductor device is lessened or there can be no level difference as shown in drawing 3 , the length of a bonding wire can be shortened and connection can be made easy.
[0012] Next, invention of the claim 3 of this application minds a solder ball. The resin substrate which is the ball grid array package carried in a printed wired board, has the loading section of a semiconductor device and has a pad for junction of the above-mentioned solder ball in an upper surface side at an undersurface side, It is in the ball grid array package characterized by establishing the heat dissipation block which approaches the upper part of the above-mentioned semiconductor device through wrap resin covering and resin covering in the semiconductor device mounted in the above-mentioned semiconductor loading section, and this semiconductor device, and promotes the heat dissipation to the upper part.
[0013] In this invention, especially the thing that should be observed is that approach the upper part of a semiconductor device and the heat dissipation block is established (refer to drawing 4). Consequently, the thermal resistance of the upper part of a semiconductor device will fall, and the heat dissipation to the upper part will be promoted. Although the above-mentioned heat dissipation block may be laid under the resin mould, it can make a heat release increase much more by making it express outside or connecting with a radiation fin.
[0014] In addition, there is a thing of structure which prepares the thick section which increases an external [in / a horizontal flank / it installs like also not only to the upper part of a semiconductor device but to a longitudinal direction, and] expression area according to claim 4, and the connection section which produces a heat flow rate between this thick section and a heat dissipation block main part in the above-mentioned heat dissipation block (refer to drawing 6). Thus, by constituting, not only the upper part but the heat dissipation from a horizontal flank is promoted, and a heat release increases

much more.
[0015] Moreover, a thing [insulating electrically between the undersurface of a heat dissipation block and semiconductor devices through a high temperature conductivity resin or a high temperature conductivity resin sheet] according to claim 5 is [like] desirable. It is because the thermal resistance between a semiconductor device and a heat dissipation block decreases and heat dissipation is promoted much more by operation of the above-mentioned high temperature conductivity resin or a high temperature conductivity resin sheet.
[0016] Moreover, the thermolysis from an inferior surface of tongue can be further promoted as mentioned above like by according to claim 6] joining the same heat sink as invention of a claim 1 to the inferior-surface-of-tongue side of the semiconductor device loading section of a resin substrate. And it is desirable to prepare the thermal beer according to claim 7 for promoting heat conduction between heat sinks in the semiconductor device loading section of a resin substrate like. It is because the thermal resistance between the inferior surface of tongue of a semiconductor device and a heat sink can be sharply decreased with thermal beer.
[0017] Moreover, in a ball grid array package according to claim 2, it is desirable to establish the thermolysis block according to claim 8 which made the semiconductor device approach the upper part of the above-mentioned semiconductor device through wrap resin covering like. The above-mentioned thermolysis block can promote the thermolysis to the upper part, as the term of a claim 3 to the claim 5 was described.
[0018] And the above-mentioned thermolysis block has some which consist of the connection section which produces a heat flow rate between the thick section which increases an external [in / a horizontal flank / it is installed to the longitudinal direction like and] expression area according to claim 9, and this thick section and a thermolysis block main part (see the publication of a claim 4 about the operation effect). Moreover, a thing [insulating electrically between the inferior surface of tongue of a thermolysis block and a semiconductor device through a high temperature conductivity resin or a high temperature conductivity resin sheet] according to claim 10 is [like] desirable (see the publication by the claim 5 about the operation effect).
[0019] Moreover, the metal block of a ball grid array package given in any 1 term of a claim 8 to the claim 10 has the plate according to claim 11 joined to the inferior surface of tongue of a resin substrate as mentioned above like (see the publication by the claim 2 about the operation effect).
[0020] Moreover, the expression section according to claim 12 to which the inferior surface of tongue of the aforementioned resin substrate was equipped with the aforementioned metal block like in the ball grid array package given in any 1 term of a claim 8 to the claim 10, and the element loading section which protrudes on the upper part from this expressional section, and inserts in the aforementioned opening can constitute (see the publication by the claim 2 about the operation effect).
[0021] And in the printed board according to claim 13 which comes to carry a ball grid array package given in any 1 term of the aforementioned claim 1, a claim 2, or a claim 6 to the claim 12 in a printed wired board, it is [like] desirable between the aforementioned heat sink of a ball grid array package or a metal block, and the above-mentioned printed wired board to be filled up with good thermally conductive adhesives or thermally conductive good grease. It is because the thermolysis to a printed wired board can be promoted through the above-mentioned thermally conductive adhesives or grease from the heat sink of a package, or a metal block by operation of the good adhesives or good grease of the above-mentioned thermal conductivity.
[0022]
[Embodiments of the Invention]
The example of one example of an operation gestalt is the partial diagrammatic view of the printed board 1 which carried the electronic parts of the ball grid array package 10 carried in a printed wired board 41 through the solder ball 12 in the printed wired board 41, as shown in drawing 1 . The ball grid array package 10 had the loading section of a semiconductor device 11, and equips the upper surface side with the resin substrate 13 which has a pad for junction of the solder ball 12 (illustration abbreviation) in an inferior-surface-of-tongue side, and the good heat sink 21 of heat conduction is joined to the inferior-surface-of-tongue side of the semiconductor device loading section of the resin substrate 13.
[0023] And in the upper part of a package 10, the fin 51 which makes the open air radiate the heat of a semiconductor device 11 is arranged suitably. Moreover, on a fin 51, the fan for compulsive air blast quenching is stationed suitably (a fin 51 and a fan are not indispensable). In this drawing, the resin mould for closure in a sign 14 and a sign 17 are bonding wires. And it fills up with good thermally conductive adhesives or thermally conductive good grease 42 between the heat sink 21 of the ball grid array package 10, and the printed wired board 41.
[0024] The ball grid array package 10 of this example has formed the heat sink 21 between printed wired boards 41, and generation of heat discharged from the inferior surface of tongue of a semiconductor device 11 radiates heat to a printed wired board 41 in the path of the simultaneously curtate distance which passes along the board thickness of the resin substrate 13, the board thickness of the above-mentioned heat sink 21, thin adhesives, or grease 42. And heat conduction, such as copper, aluminum, a copper tungsten, and covar, is formed with a good material, and the heat sink 21 has the board configuration with little [geometrically] thermal resistance. Moreover, adhesives or grease 42 consists of a silicon system resin, and since the thermal conductivity is very good, a semiconductor device 11 can emit heat efficiently to a printed wired board 41.
[0025] Moreover, the structure which joins a heat sink 21 to the resin substrate 13 is very simple, manufacture is easy, and elevation of a manufacturing cost can be lessened. The graph shown in (a) of drawing 9 and (b) shows the permission calorific value to the element 11 the case where the conventional ball grid array package 900 shown in drawing 10 is used, and at the time of using the ball grid array package 10 of this example (the package 900 is the same as that of a package 10 except for the existence of a heat sink 21).
[0026] That is, as for (a) of this drawing, (b) of this drawing shows permission calorific value [as opposed to the ball grid array package 10 of this example for the permission calorific value to the conventional ball grid array package 900]. And the case where a left-hand side bar graph has a fin 51 is shown, and the right-hand side bar graph shows the case where there is no fin 51. In addition, the thermal resistance of the used fin 51 is 1.5-degree-C/W. Permission calorific value can be made to increase by 30 to no less than 80% by using the package 10 of this example, as shown in this drawing.
[0027] The example of two examples of an operation form changes the structure of a ball grid array package in the example

1 of an operation form, as shown in drawing 2 . That is, the opening 151 of the resin substrate 15 which has a pad for junction of the solder ball 12 (illustration abbreviation) in an undersurface side while forming opening 151 in the helicopter loading site of a semiconductor device 11, and the resin substrate 15 was equipped with the ball grid array package 101 of this example, it carried the semiconductor device 11 in the upper surface, and is equipped with the metal block 22 of the plate which comes to open an undersurface side wide in the open air.

[0028] With the package 101 of this example, the semiconductor device 11 is carried in the metal block 22 instead of the resin substrate 15, and the metal block 22 is joined to the printed wired board 41 which does not illustrate the undersurface through the aforementioned adhesives or aforementioned grease with good heat conduction which is not illustrated. Therefore, the opening 151 for arranging the metal block 22 is formed in the helicopter loading site of the semiconductor device 11 of the resin substrate 15. By carrying a semiconductor device 11 in the metal block 22 as mentioned above, it is connected by the metal block 22 with small thermal resistance between the undersurface of a semiconductor device 11, and a printed wired board 41, and it becomes very good [heat dissipation]. In addition, the quality of the materials of the metal block 22 are copper, aluminum, a copper tungsten, covar, etc.

[0029] Consequently, as shown in (d) of drawing 9 , the permission calorific value of a semiconductor device 11 was able to be increased 97 to no less than 150% compared with the conventional package 900 shown in (a) of this drawing. About others, it is the same as that of the example 1 of an operation form.

[0030] The example of three examples of an operation form changes the structure of a metal block of a ball grid array package in the example 2 of an operation form, as shown in drawing 3 . That is, the metal block 23 of the ball grid array package 102 of this example has the expressional section 231 with which the undersurface of the resin substrate 15 was equipped, and the element loading section 232 which protrudes on the upper part from this expressional section 231, and inserts in opening 151.

[0031] Consequently, as shown in (c) of drawing 9 , the permission calorific value of a semiconductor device 11 was able to be increased 92 to no less than 150% compared with the conventional package 900 shown in (a) of this drawing. About others, it is the same as that of the example 2 of an operation form.

[0032] The example of four examples of an operation form changes the structure of a ball grid array package in the example 1 of an operation form, as shown in drawing 4 . That is, the heat dissipation block 24 which the ball grid array package 103 of this example approaches the upper part of a semiconductor device 11 through the wrap resin covering 14 and the resin covering 14 in the resin substrate 13 which has the loading section of a semiconductor device 11 and has a pad for junction of the solder ball 12 in an upper surface side at an undersurface side, the semiconductor device 11 mounted in the above-mentioned semiconductor device loading section, and this semiconductor device 11, and promotes the heat dissipation to the upper part is established. Consequently, the thermal resistance to the upper part of a semiconductor device 11 falls, and the heat dissipation to the upper part is promoted.

[0033] Consequently, as shown in (e) of drawing 9 , when a fin 51 was attached, the heat dissipation to the upper part is promoted and the permission calorific value of a semiconductor device 11 was able to be increased about 53% compared with the conventional package 900 shown in (a) of this drawing. About others, it is the same as that of the example 1 of an operation form.

[0034] The example of five examples of an operation gestalt changes the structure of a ball grid array package in the example 3 of an operation gestalt, as shown in drawing 5 . That is, in the ball grid array package 104 of this example, the thermolysis block 24 which promotes the heat dissipation to the upper part of a semiconductor device 11 is established. Consequently, as shown in (f) of drawing 9 , the permission calorific value of a semiconductor device 11 was able to be increased 137 to no less than 150% compared with the conventional package 900 shown in (a) of this drawing. About others, it is the same as that of the example 3 of an operation gestalt.

[0035] The example of six examples of an operation gestalt changes the structure of a thermolysis block of a ball grid array package in the example 4 of an operation gestalt, as shown in drawing 6 . That is, in the ball grid array package 105 of this example, the thermolysis block 25 is installed to the longitudinal direction, and has the thick section 252 which increases the external expression area in a horizontal flank, and the connection section 253 which produces a heat flow rate between this thick section 252 and the thermolysis block main part 251.

[0036] So, not only the upper part but the heat dissipation from a horizontal flank is promoted, and a heat release increases much more. Consequently, as shown in (g) of drawing 9 , the permission calorific value of a semiconductor device 11 was able to be increased 134 to no less than 158% compared with the conventional package 900 shown in (a) of this drawing. About others, it is the same as that of the example 4 of an operation form.

[0037] The example of seven examples of an operation form changes the structure of a heat dissipation block of a ball grid array package in the example 5 of an operation form, as shown in drawing 7 . That is, in the ball grid array package 106 of this example, the heat dissipation block 25 is installed to the longitudinal direction, and has the thick section 252 which increases the external expression area in a horizontal flank, and the connection section 253 which produces a heat flow rate between this thick section 252 and the heat dissipation block main part 251.

[0038] So, not only the upper part but the heat dissipation from a horizontal flank is promoted, and a heat release increases much more. Consequently, as shown in (h) of drawing 9 , the permission calorific value of a semiconductor device 11 was able to be increased 203 to no less than 242% compared with the conventional package 900 shown in (a) of this drawing. About others, it is the same as that of the example 5 of an operation form.

[0039] The example of eight examples of an operation form forms thermal beer 27 in the resin substrate 13 of a ball grid array package in the example 1 of an operation form, as shown in drawing 8 . The thermal resistance between the undersurface of a semiconductor device 11 and a heat sink 21 can be sharply decreased with thermal beer 27. About others, it is the same as that of the example 1 of an operation form.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The typical cross section of the electronic parts using the ball grid array package of the example 1 of an operation gestalt.
[Drawing 2] The typical cross section of the electronic parts using the ball grid array package of the example 2 of an operation gestalt.
[Drawing 3] The typical cross section of the electronic parts using the ball grid array package of the example 3 of an operation gestalt.
[Drawing 4] The typical cross section of the electronic parts using the ball grid array package of the example 4 of an operation gestalt.
[Drawing 5] The typical cross section of the electronic parts using the ball grid array package of the example 5 of an operation gestalt.
[Drawing 6] The typical cross section of the electronic parts using the ball grid array package of the example 6 of an operation gestalt.
[Drawing 7] The typical cross section of the electronic parts using the ball grid array package of the example 7 of an operation gestalt.
[Drawing 8] The typical cross section of the electronic parts using the ball grid array package of the example 8 of an operation gestalt.
[Drawing 9] Drawing which illustrated the permission calorific value of the element of the electronic parts using the ball grid array package of the examples 1-8 of an operation gestalt with the case where the conventional ball grid array package is used (as for a left-hand side bar graph, in with a fin, a right-hand side bar graph shows the case where he has no fin).
[Drawing 10] The typical cross section of the electronic parts using the conventional ball grid array package.
[Drawing 11] The cross section of the electronic parts using the conventional ball grid array package.
[Description of Notations]
10 ... a ball grid array package
11 ... a semiconductor device
13 ... a resin substrate
21 ... a heat sink
41 ... a printed wired board

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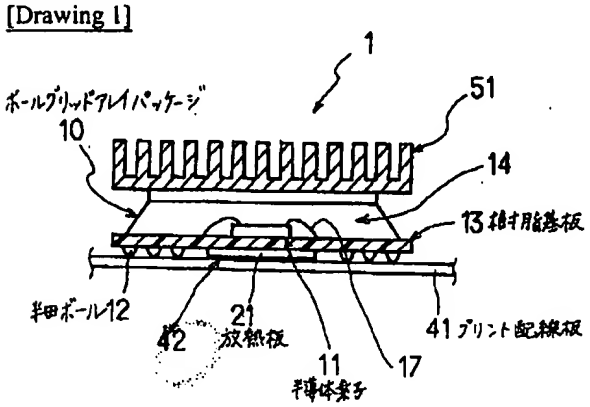
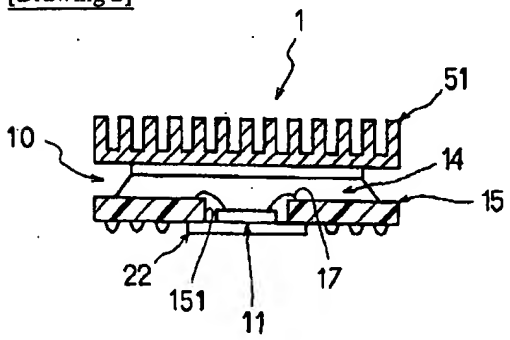
DRAWINGS

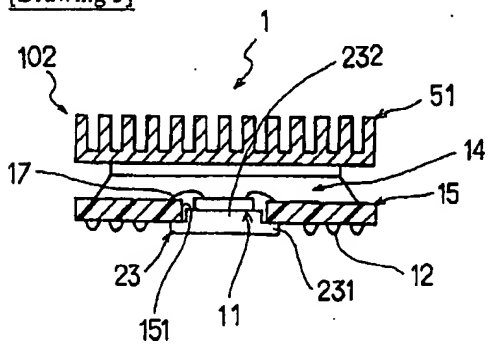
[Drawing 1]



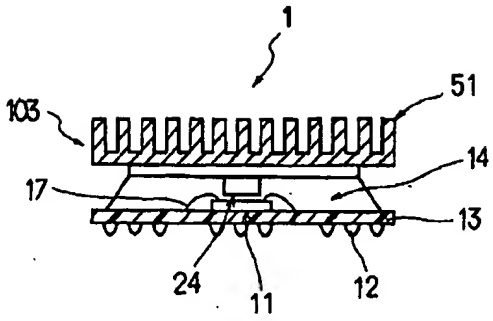
[Drawing 2]



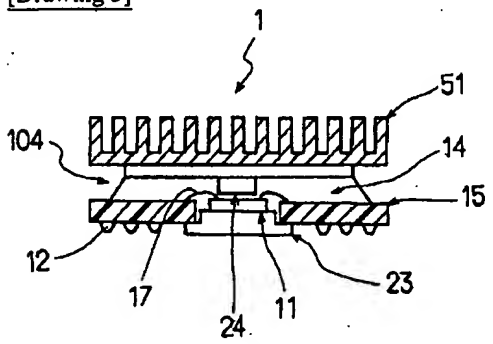
[Drawing 3]



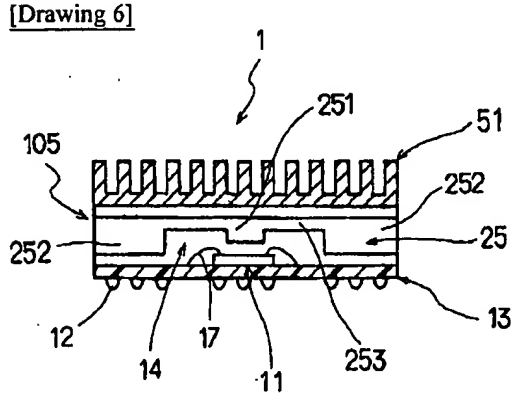
[Drawing 4]



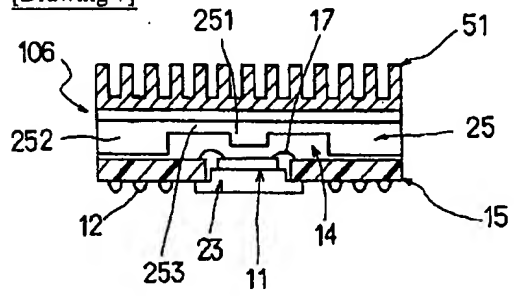
[Drawing 5]



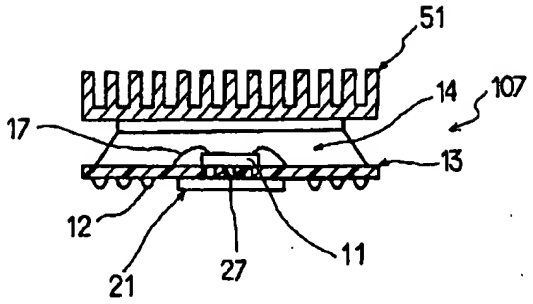
[Drawing 6]



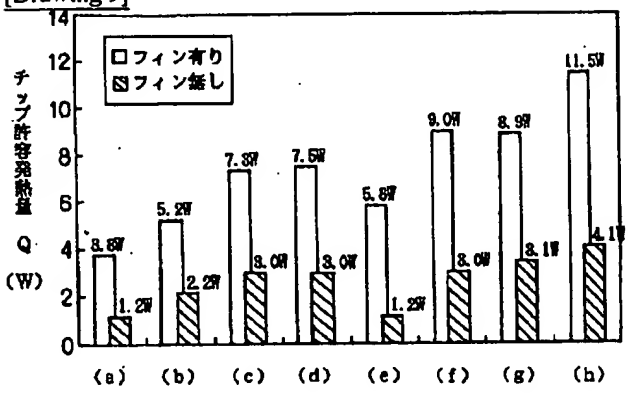
[Drawing 7]



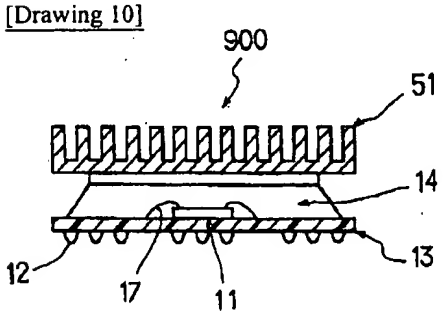
[Drawing 8]



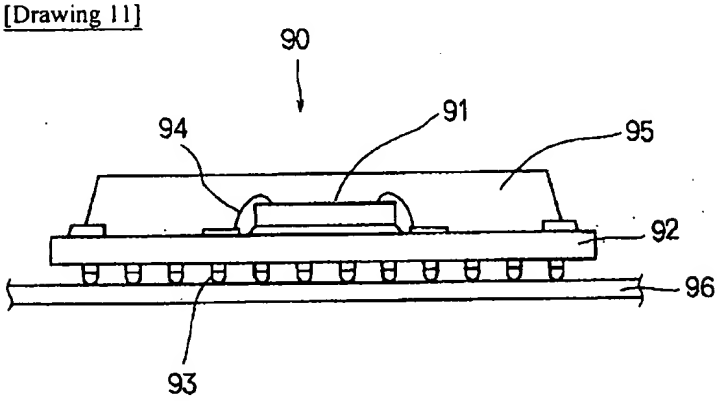
[Drawing 9]



[Drawing 10]



[Drawing 11]



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